City of Alexandria, Virginia

Long-Term Control Plan Update

Progress Report

VDEQ
May 11, 2015

City of Alexandria, Virginia

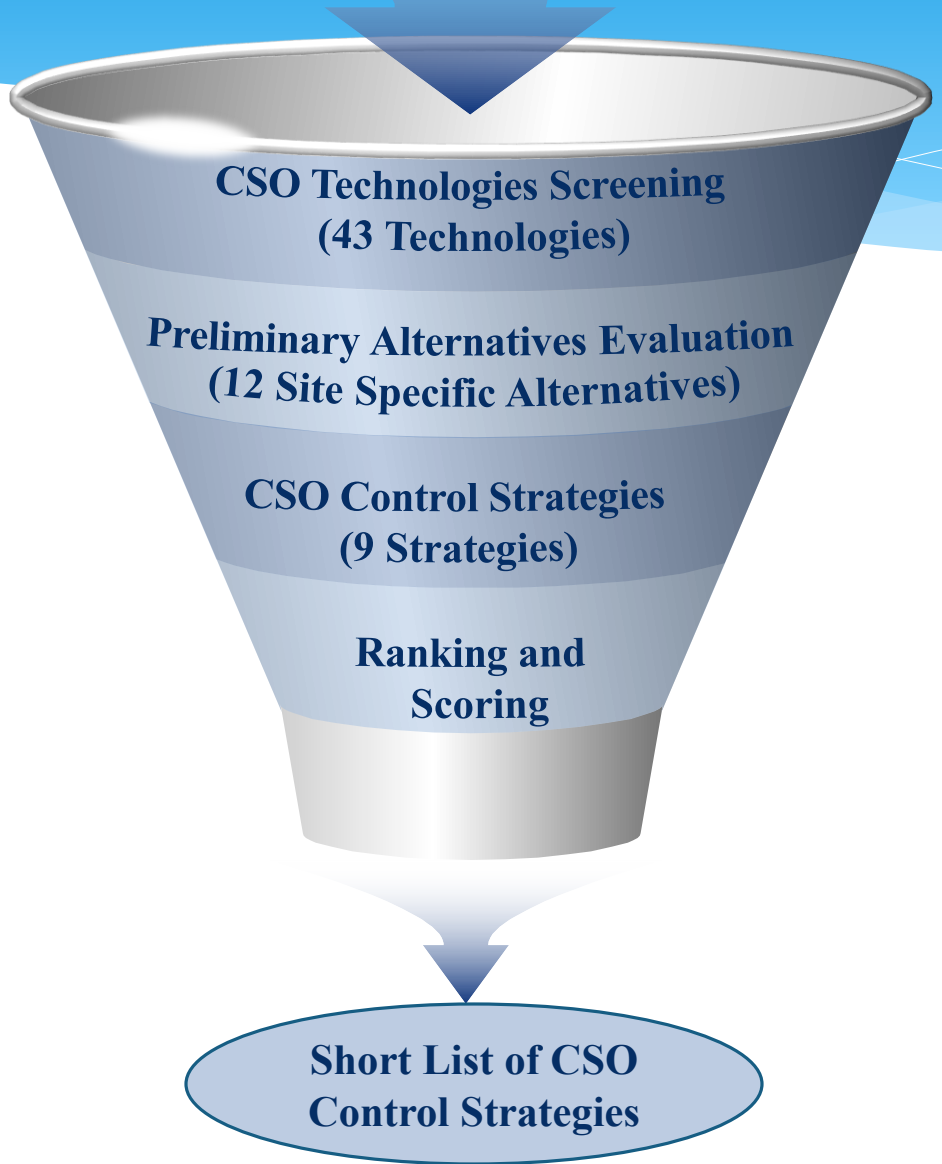
AGENDA

- Technical Memoranda Status Update
- Alternatives for Detailed Evaluation
- Water Quality Modeling
  - Presumption Approach
  - Demonstration Approach
  - Waste Load Allocation
- Phase 2 Public Outreach
- Next Steps

Technical Memoranda Status

Tech Memo	Status – Provide to DEQ
Work Plan	Complete – May 2014
CSS Characterization	Complete – September 2014
Flow Projections	Complete – September 2014
Typical Year Selection	Complete – September 2014
Regulatory Requirements	Complete – October 2014
Public Participation Plan	Complete – October 2014
CSS Sewershed Changes	Complete – January 2015
H&H Modeling Plan	Complete – January 2015
CSO Technologies Screening	Complete – January 2015
Evaluation Criteria	Draft Final Status
Basis for Cost Estimating	Draft Final Status
Detailed Alternatives Evaluation (5)	Draft Final Status
Water Quality Modeling	Draft Final Status
Ranking and Recommendation	Draft Final Status

LTCPU Decision Process



City of Alexandria, Virginia

Evaluation Criteria

Evaluation Criteria

Evaluation Criteria	Example Rating Score Qualifications					
	Very High (5 points)	High (4 points)	Medium (3 points)	Low (2 points)	Minimal (1 point)	None (0 points or N/A)
Cost (40%)	Lowest Cost	Low Cost	Moderate Cost	High Cost	Highest Cost	N/A
CSO Reduction (Volume) (10%)	>95% reduction	Reduction 75-95%	Reduction 50-74%	Reduction 25-49%	<25% reduction	No reduction
Effectiveness (15%)	Removal of all bacteria from Hunting Creek	High bacteria reduction	Moderate bacteria reduction	Low bacteria reduction	Minimal bacteria reduction	No reduction
Implementation Effort (5%)	"Yes" to 5 questions	"Yes" to 4 questions	"Yes" to 3 questions	"Yes" to 2 questions	"Yes" to 1 or 0 questions	"Yes" to 0
Impact to the Community (10%)	Improved quality of live and minimal negative impact during implementation		Some negative impact during implementation	Excessive negative impact during implementation		N/A
Expandability (2.5%)	Multiple options and space for expansion		Few options and space for expansion	Limited options and space for expansion	No opportunities for expansion	N/A
Net Environmental Benefit (5%)	Base score + >35	Base score + 26-35	Base score + 16-25	Base score + 6-15	Base score + 0-5	N/A
Nutrient Credits for the Chesapeake Bay TMDL (5%)	Nitrogen: >2,000 Phosphorous: >400 Sediment: >40,000	Nitrogen: 1,500 - 1,999 Phosphorous: 300 - 399 Sediment: 30,000 - 39,999	Nitrogen: 1,000 - 1,499 Phosphorous: 200 - 299 Sediment: 20,000 - 29,999	Nitrogen: 500 - 999 Phosphorous: 100 - 199 Sediment: 10,000 - 19,999	Nitrogen: 0 - 499 Phosphorous: 0 - 99 Sediment: 0 - 9,999	No opportunity for credits
Permitting Issues (2.5%)	No risk of permitting issues	Minimal risk of permitting issues	Moderate risk of permitting issues	Significant risk of permitting issues		N/A
Required Maintenance (5%)	No required maintenance	Few and infrequent maintenance	Frequent maintenance	Frequent and expensive maintenance		N/A

Technologies Evaluated

- Stormwater Management
  - Street/Parking Lot Storage (catch basin control)
  - Catch Basin Modification (for floatables control)
  - Green Infrastructure
- Public Education & Outreach
  - Water Conservations
  - Catch Basin Stenciling
  - Community Cleanup Programs
  - Public Education Programs
  - FOG Program
  - Garbage Disposal Restriction
  - Pet Waste Management
- Ordinance Enforcement
  - Construction Site Erosion & Sediment Controls
  - Illegal Dumping Control
  - Pet Waste Control
  - Litter Control
  - Illicit Connection Control
- Good Housekeeping
  - Street Sweeping / Flushing
  - Leaf Collection
  - Recycling Programs
- Operation & Maintenance
  - I/I Reduction
  - Advanced System Inspection & Maintenance
  - Combined Sewer Flushing
  - Catch Basin Cleaning
- Combined Sewer Separation
  - Roof Leader Disconnection
  - Sump Pump Disconnection
  - Complete Separation
- Combined Sewer Optimization
  - Conveyance
  - Regulator Modifications
  - Outfall Consolidation / Relocation
  - Real Time Controls
- Linear Storage
  - Pipeline
  - Tunnel
- Point Storage
  - Tank
  - Wet Weather Storage Basin – AlexRenew WRRF
- Treatment – CSO Facility
  - Vortex Separators
  - Screens
  - Netting
  - Contaminant Booms
  - Baffles
  - Disinfection
  - High Rate Physical / Chemical Treatment (ActiFlow®)
  - High Rate Physical (Fuzzy Filters®)
- Treatment – WRRF
  - Additional Treatment Capacity – AlexRenew WRRF
  - Wet Weather Blending – AlexRenew WRRF

Technologies for Consideration

* Stormwater Management
  - Green Infrastructure
* Combined Sewer Separation
  - Complete Separation
* Linear Storage
  - Tunnel
* Point Storage
  - Tank
* Treatment – CSO Facility
  - Disinfection

City of Alexandria, Virginia

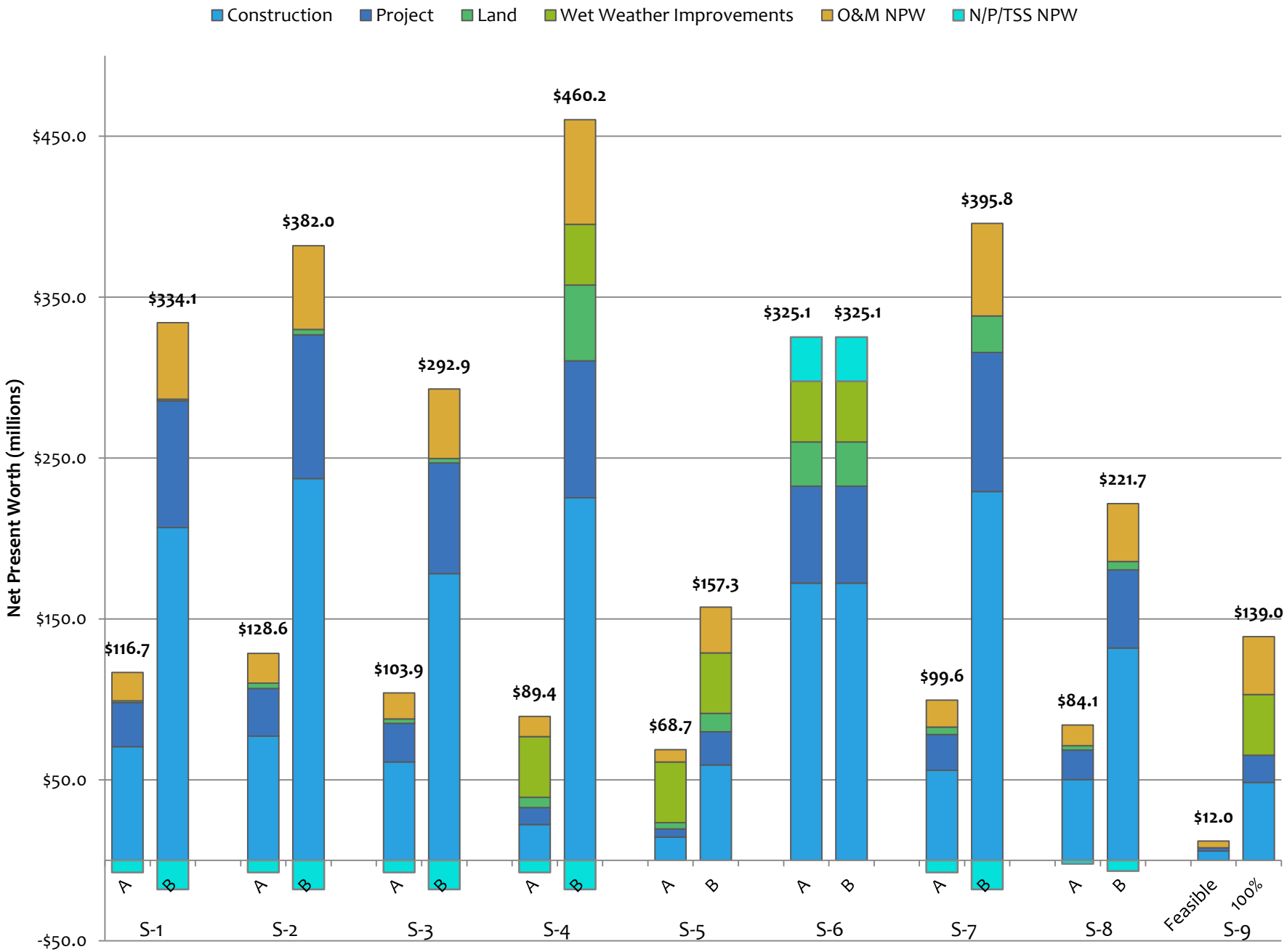
Alternatives for Detailed Evaluation

Technology Alternatives

Alternative	Technology	Outfall	Receiving Waters
T1	Storage Tunnel	CSO-003/4	Hooffs Run
T2	Storage Tunnel	CSO-002/3/4	Hooffs Run & Hunting Creek Embayment
T3	Storage Tunnel	CSO-002/3/4	Potomac River
T4	Storage Tunnel	CSO-002	Potomac River
ST002	Storage Tank	CSO-002	Hunting Creek Embayment
ST003/4	Storage Tank	CSO-003/4	Hooffs Run
D002	Disinfection Tank	CSO-002	Hunting Creek Embayment
D003/4	Disinfection Tank	CSO-003/4	Hooffs Run
SE002	Full Separation	CSO-002	None
SE003/4	Full Separation	CSO-003/4	None
GI002	Green Infrastructure	CSO-002	Hunting Creek Embayment
GI003/4	Green Infrastructure	CSO-003/4	Hooffs Run

Summary of CSO Control Strategies

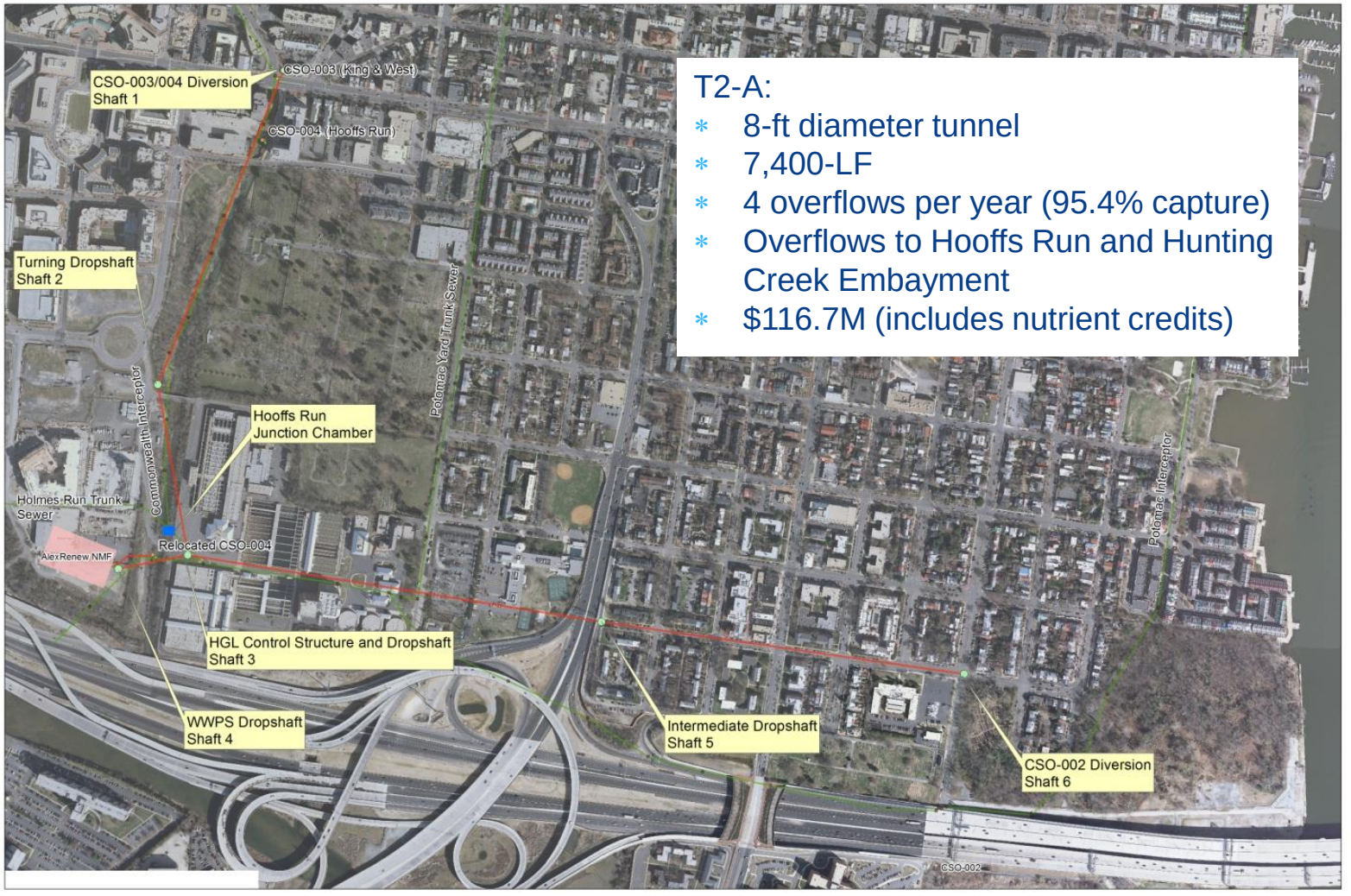
Strategy No.	CSO Control Strategy	Combination of Technology Alternatives	Receiving Waters
S-1	One Storage Tunnel for CSO-002/3/4	T2-A	Hooffs Run
S-2	One Storage Tunnel CSO-002/3/4 and Outfall Relocation to the Potomac	T3-A	Potomac River
S-3	Separate Storage Tunnels CSO-002 and CSO-003/4 and Outfall Relocation for CSO-002 to the Potomac	T1-A	Hooffs Run
		T4-A	Potomac River
S-4	All Storage Tanks	ST003/4-A	Hooffs Run
		ST002-A	Hunting Creek Embayment
S-5	All Disinfection	D003/4-A	Hooffs Run
		D002-A	Hunting Creek Embayment
S-6	All Separation	SE003/4-King & West	N/A
		SE002-Royal	N/A
S-7	Storage Tunnel for CSO-003/4 and Storage Tank at CSO-002	T1-A	Hooffs Run
		ST002-A	Hunting Creek Embayment
S-8	Storage Tunnel for CSO-003/4 and Disinfection at CSO-002	T1-A	Hooffs Run
		D002-A	Hunting Creek Embayment
S-9	All Green Infrastructure	GI003/4-King & West	Hooffs Run
		GI002-Royal	Hunting Creek Embayment


Construction
Project
Land
Wet Weather Improvements
O&M NPW
N/P/TSS NPW
Net Present Worth (millions)
$450.0
$350.0
$250.0
$150.0
$50.0
-$50.0
$116.7
$334.1
$128.6
$382.0
$103.9
$292.9
$89.4
$460.2
$68.7
$157.3
$325.1
$325.1
$99.6
$395.8
$84.1
$221.7
$12.0
$139.0
A
B
S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
Feasible
100%
S-9

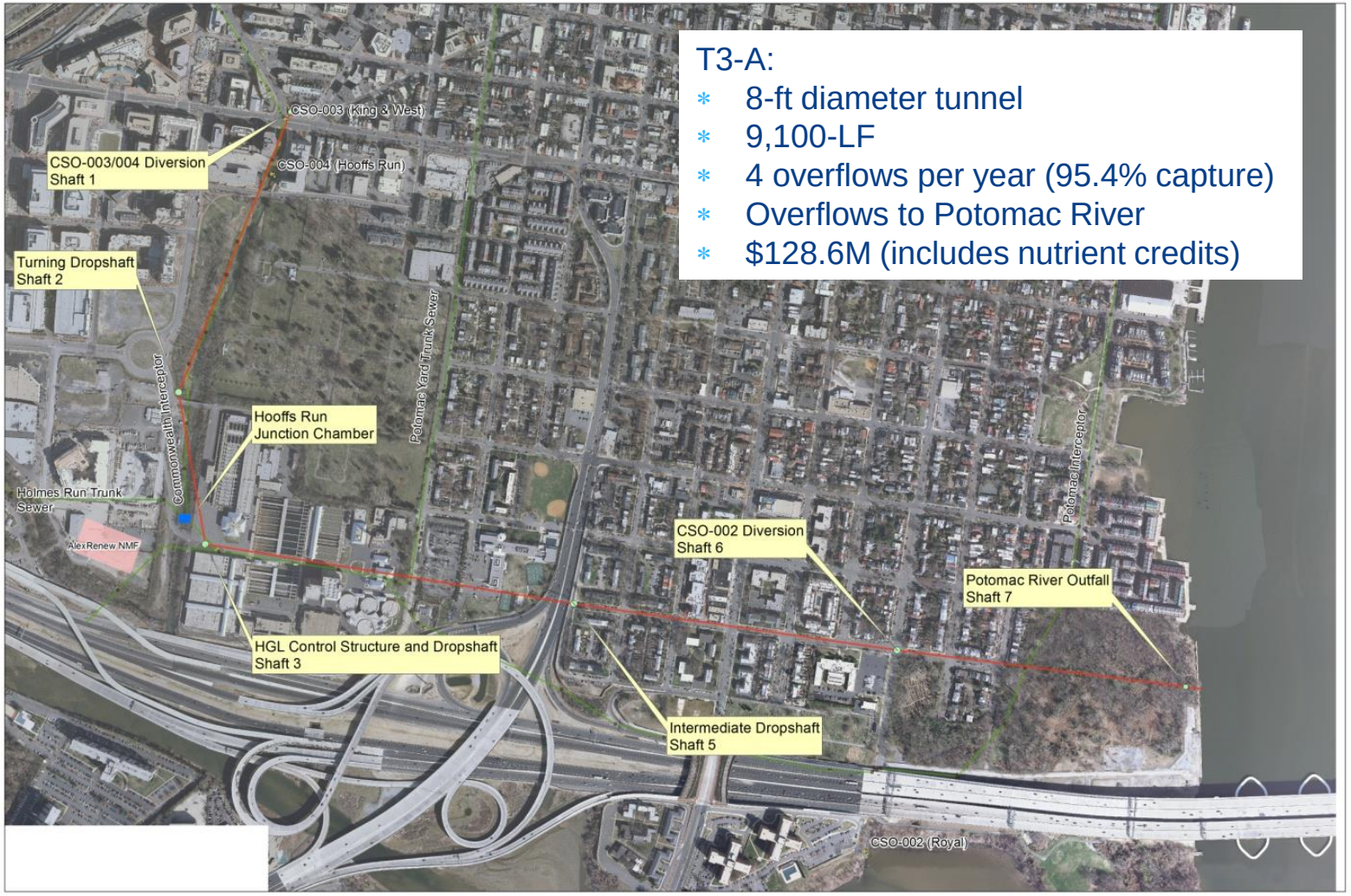
Scenario B Alternatives

* Cost 3-5 times more than the Scenario A alternatives
* Siting the very large infrastructure is extremely difficult in the highly urbanized area of Old Town
* Includes an extreme 67-year rainfall event
* Not needed for the Presumption Approach
* Scenario A sizing meets the 2004-2005 TMDL period Demonstration Approach requirements
* Scenario A sizing meets the 2004-2005 TMDL period Waste Load Allocation with Collective Consistency

S-1: One Storage Tunnel for CSO-002/3/4



S-2: One Storage Tunnel for CSO-002/3/4 and Outfall Relocation to the Potomac

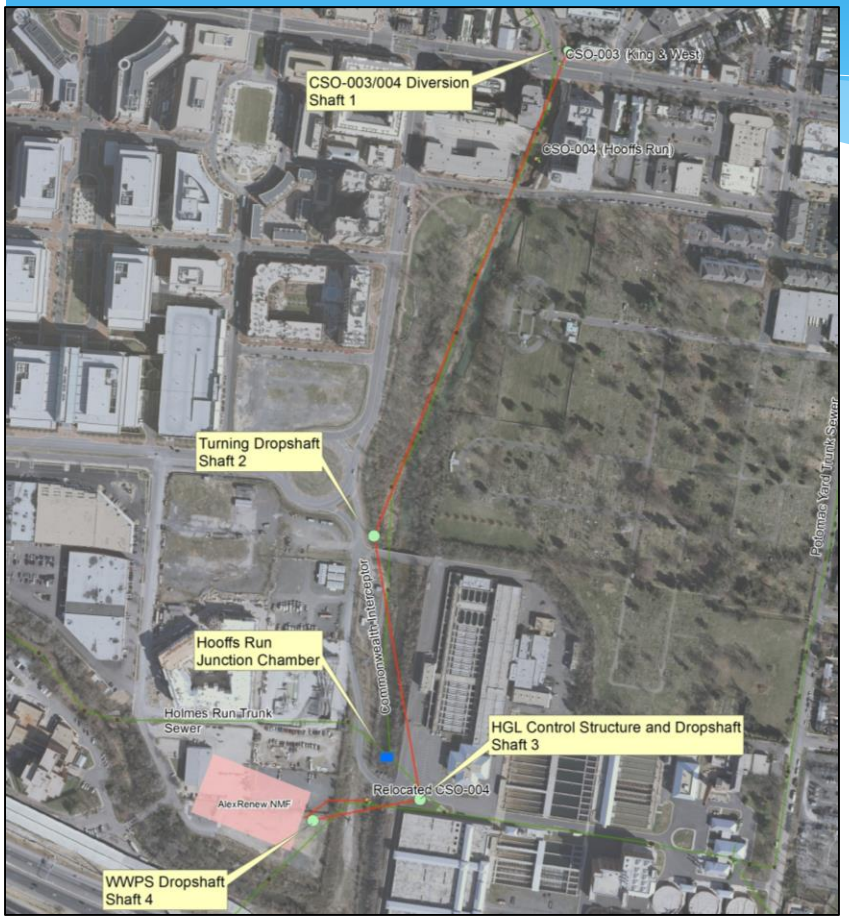


T3-A:

- 8-ft diameter tunnel
- 9,100-LF
- 4 overflows per year (95.4% capture)
- Overflows to Potomac River
- $128.6M (includes nutrient credits)

S-3: Separate Storage Tunnels CSO-002 and CSO-003/4 and Outfall Relocation for CSO-002 to the Potomac

Total Cost: $103.9M
(includes nutrient credits)



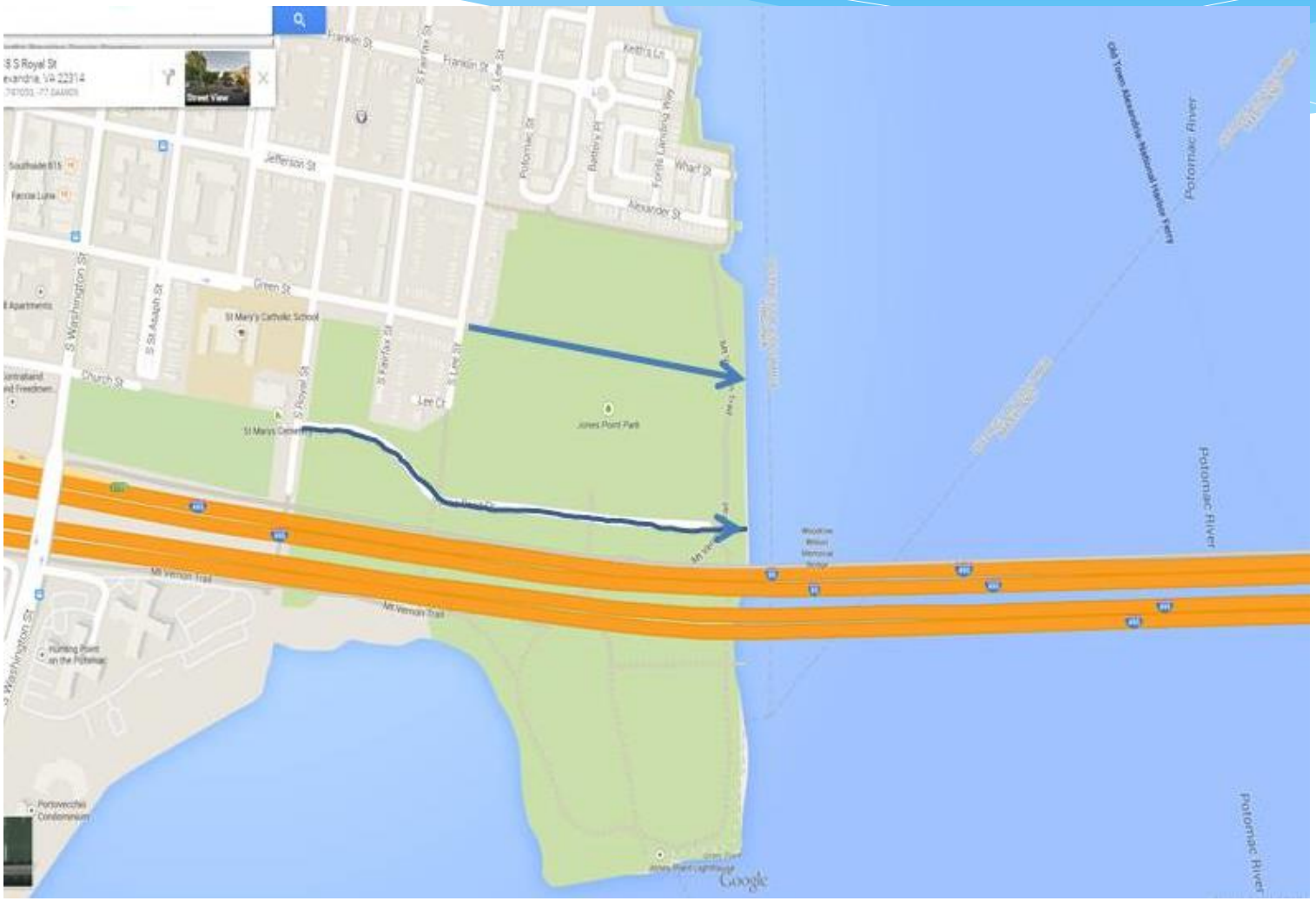
T1-A:

- 8-ft diameter tunnel
- 2,600-LF
- 3 overflows per year (96.9% capture)
- Overflows to Hooffs Run

T4-A:

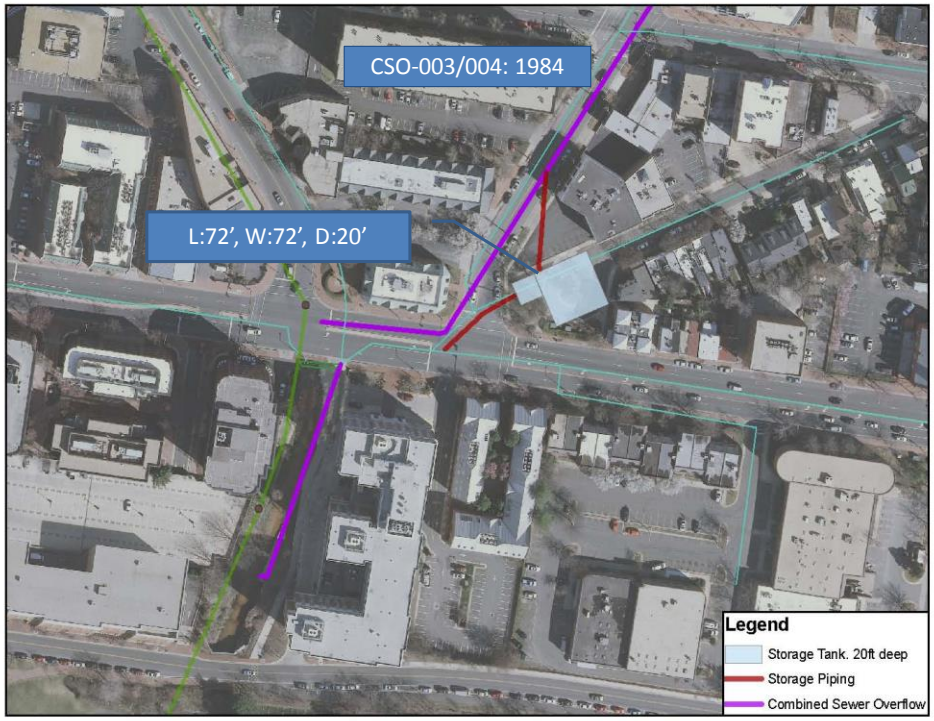
- 15-ft diameter tunnel
- 1,700-LF
- 4 overflows per year (94.2% capture)
- Overflows to Potomac River

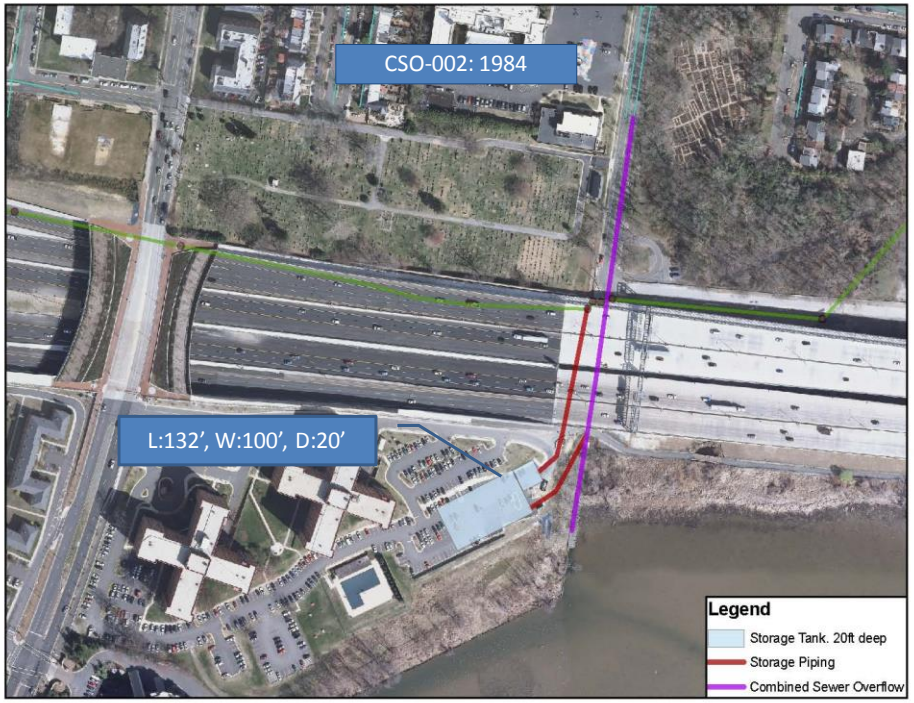
Virginia Potomac Waters To be Confirmed



S-4: All Storage Tanks

Total Cost: $89.4M
(includes nutrient credits)





ST003/4-A

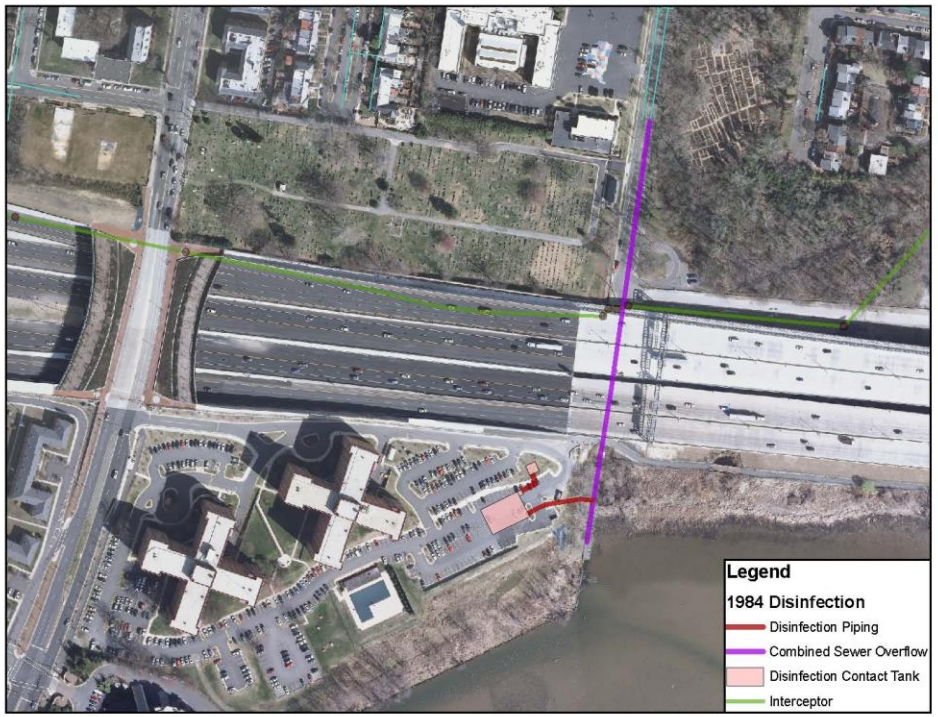
* 0.8 MG storage tank
* 4 overflows per year (96.1% capture)
* Overflows to Hooffs Run

ST002-A

* 2.0 MG storage tank
* 4 overflows per year (94.2% capture)
* Overflows to Hunting Creek Embayment

S-5: All Disinfection

Total Cost: $68.7M
(no nutrient credits)



D003/4-A

* 2,000 gallon chemical storage tank
* No CSO volume reduction
* Overflows to Hooffs Run

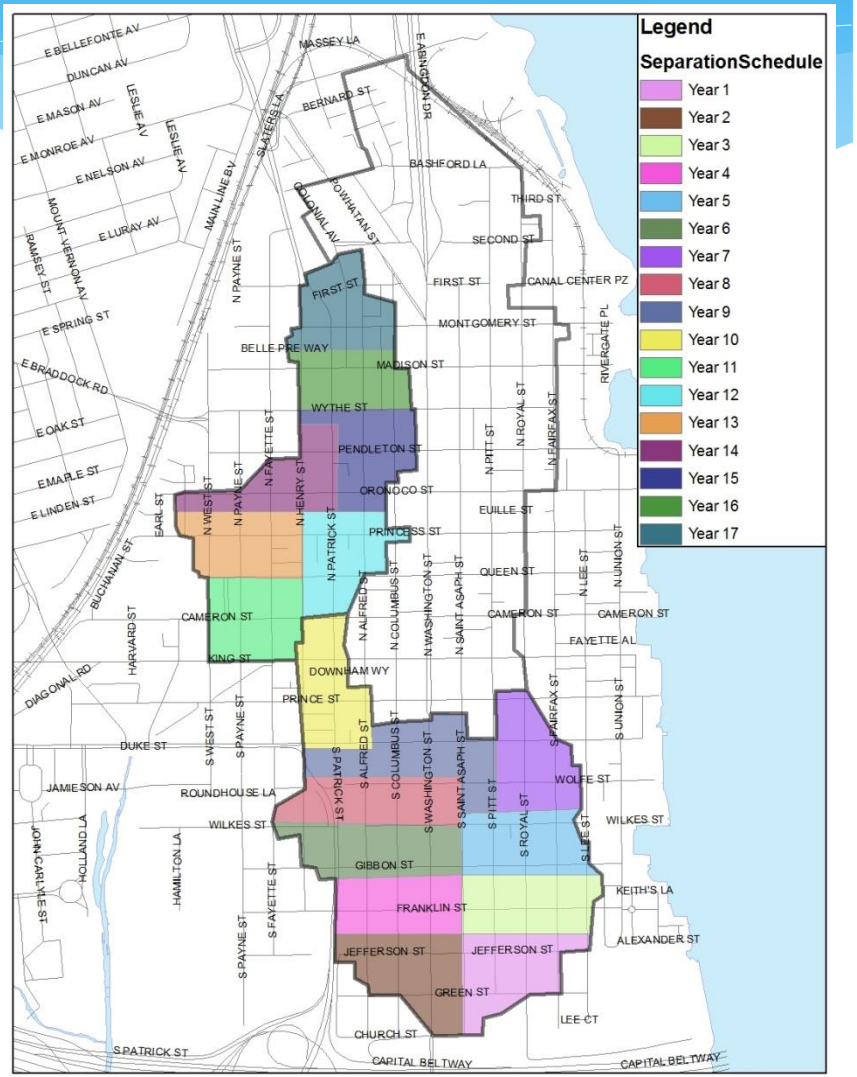
D002-A

* 4,400 gallon chemical storage tank
* No CSO volume reduction
* Overflows to Hunting Creek Embayment

S-6: All Separation

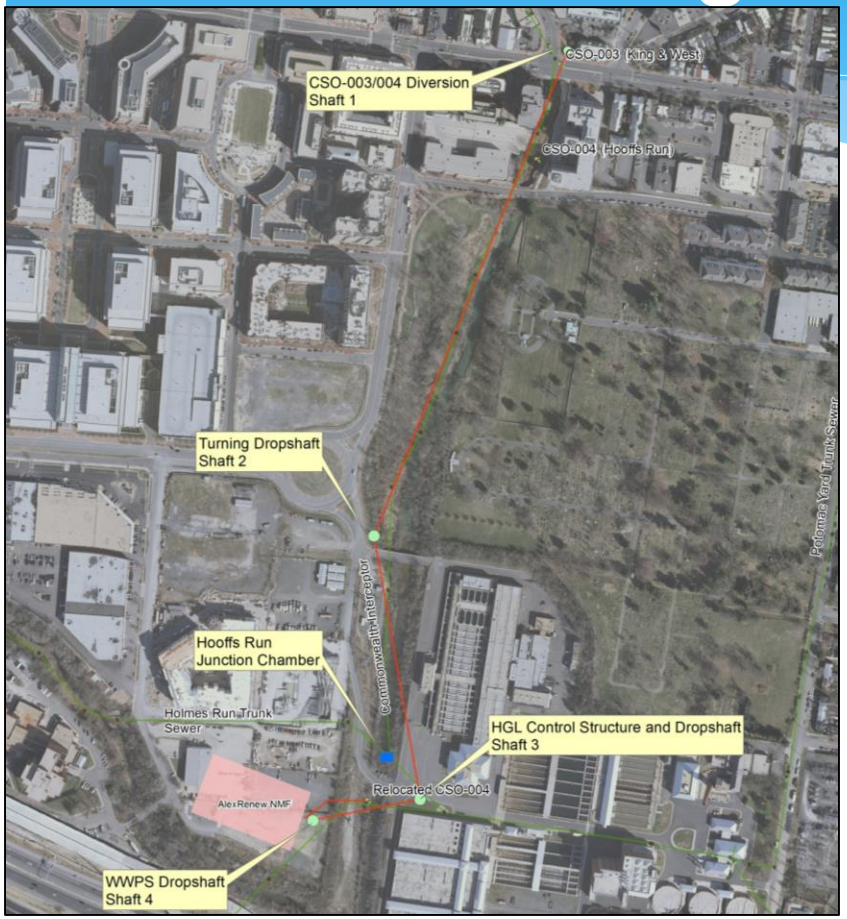
- CSS Area ≈ 314 acres
- Assuming a 17-year schedule
- 19 acres under construction continuously for 17 years
- Assumes Year 1 starts in 2018
- Construction ends at the end of 2035
- Not as much bacteria reduction as store and treat
- Additional area added to City's MS4 permit

- Total Cost: $325.1M (additional nutrient costs)



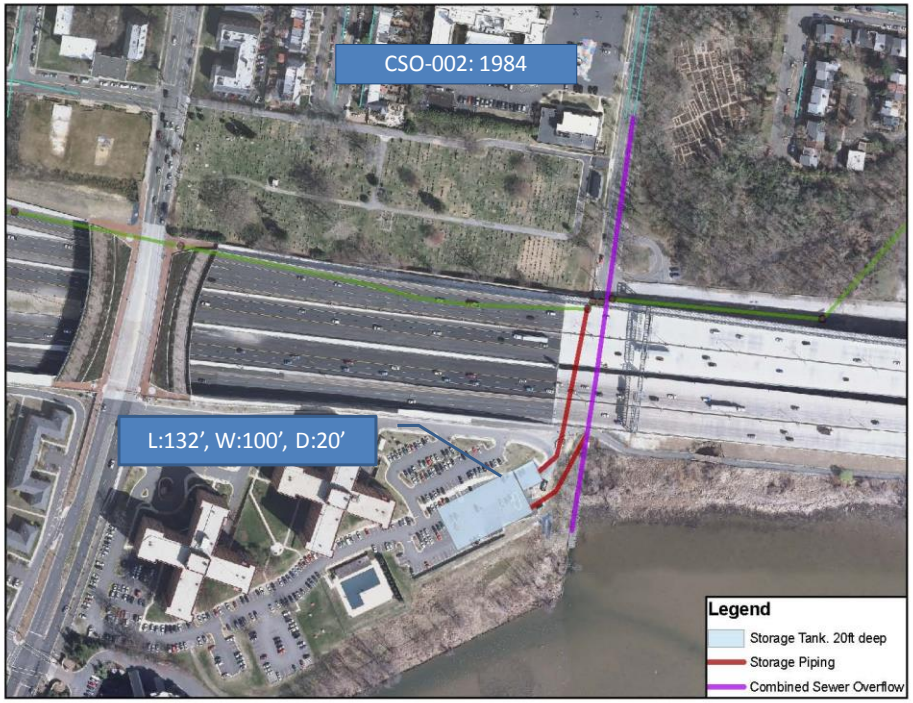
S-7: Storage Tunnel for CSO-003/4 and Storage Tank at CSO-002

Total Cost: $99.6M
(included nutrient credits)



T-1

- 8-ft diameter tunnel
- 2,600-LF
- 3 overflows per year (96.9% capture)
- Overflows to Hooffs Run

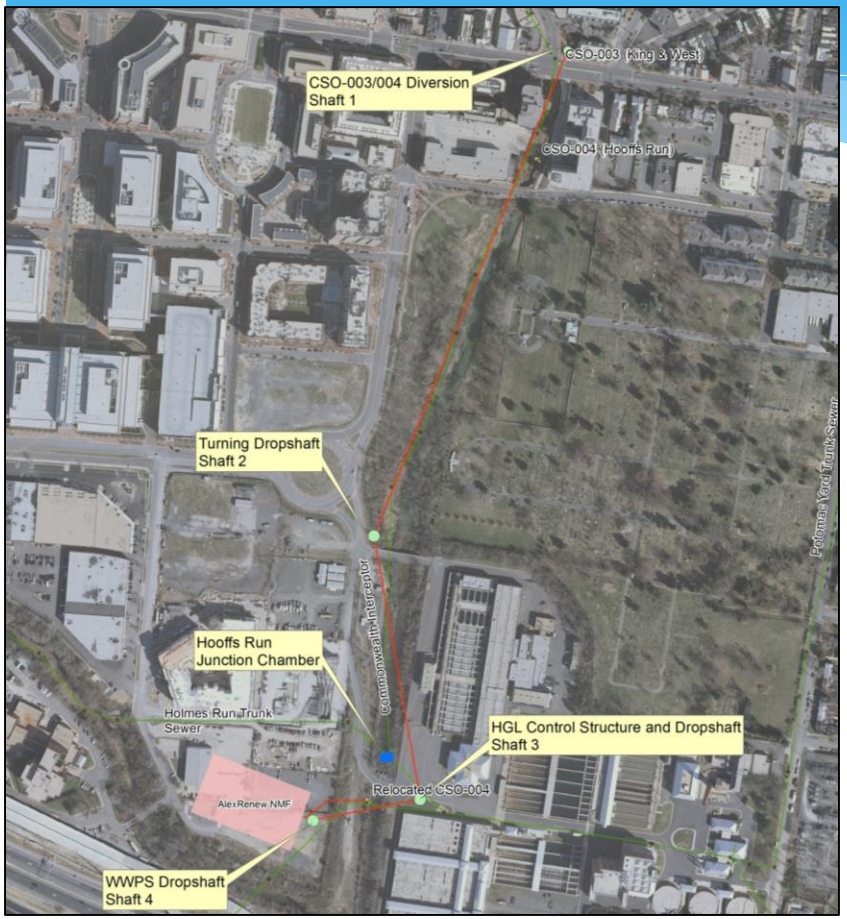


ST002-A

- 2.0 MG storage tank
- 4 overflows per year (94.2% capture)
- Overflows to Hunting Creek Embayment

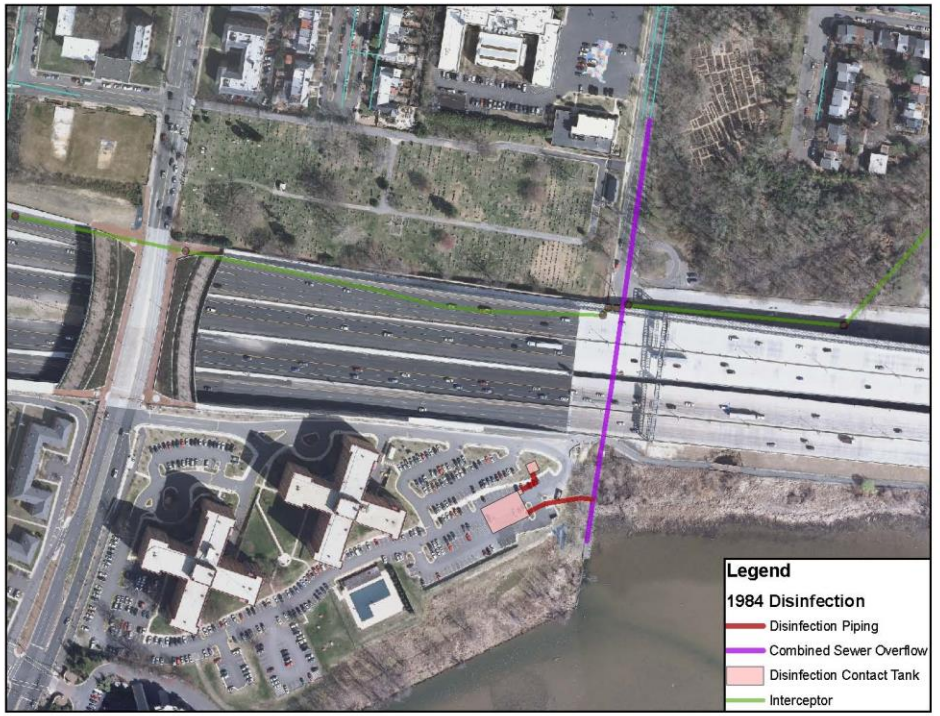
S-8: Storage Tunnel for CSO-003/4 and Disinfection at CSO-002

Total Cost: $84.1M
(includes nutrient credits)



T-1

- 8-ft diameter tunnel
- 2,600-LF
- 3 overflows per year (96.9% capture)
- Overflows to Hooffs Run



D002-A

- 4,400 gallon chemical storage tank
- No CSO volume reduction
- Overflows to Hunting Creek Embayment

S-9: All Green Infrastructure

* 100% GI Implementation
  - What If Analysis
  - Target 100% of City-owned parcel area
  - Target 100% of City Right-of-Way area
  - 2.0 MG capture per 1” storm
* Realistic GI Implementation
  - Target 60% of City-owned property area
  - Target 10% of City Right-of-Way area
  - 340,000 gallon capture per 1” storm

Year	Overflow Volume (MG)	100% GI Implementation	
		(MG)	(%)
1984	60.8	52.9	13.0%
2004-2005	162.1	152.8	5.7%

Control Strategy Ranking

Rank	Strategy No.	CSO Control Strategy
1	S-7	Storage Tunnel for CSO-003/4 and Storage Tank at CSO-002
2	S-3	Separate Storage Tunnels CSO-002 and CSO-003/4 and Outfall Relocation for CSO-002 to the Potomac
3	S-1	One Storage Tunnel for CSO-002/3/4
4	S-4	All Storage Tanks
5	S-8	Storage Tunnel for CSO-003/4 and Disinfection at CSO-002
6	S-2	One Storage Tunnel CSO-002/3/4 and Outfall Relocation to the Potomac
7	S-5	All Disinfection
8	S-9	All Green Infrastructure
9	S-6	All Separation

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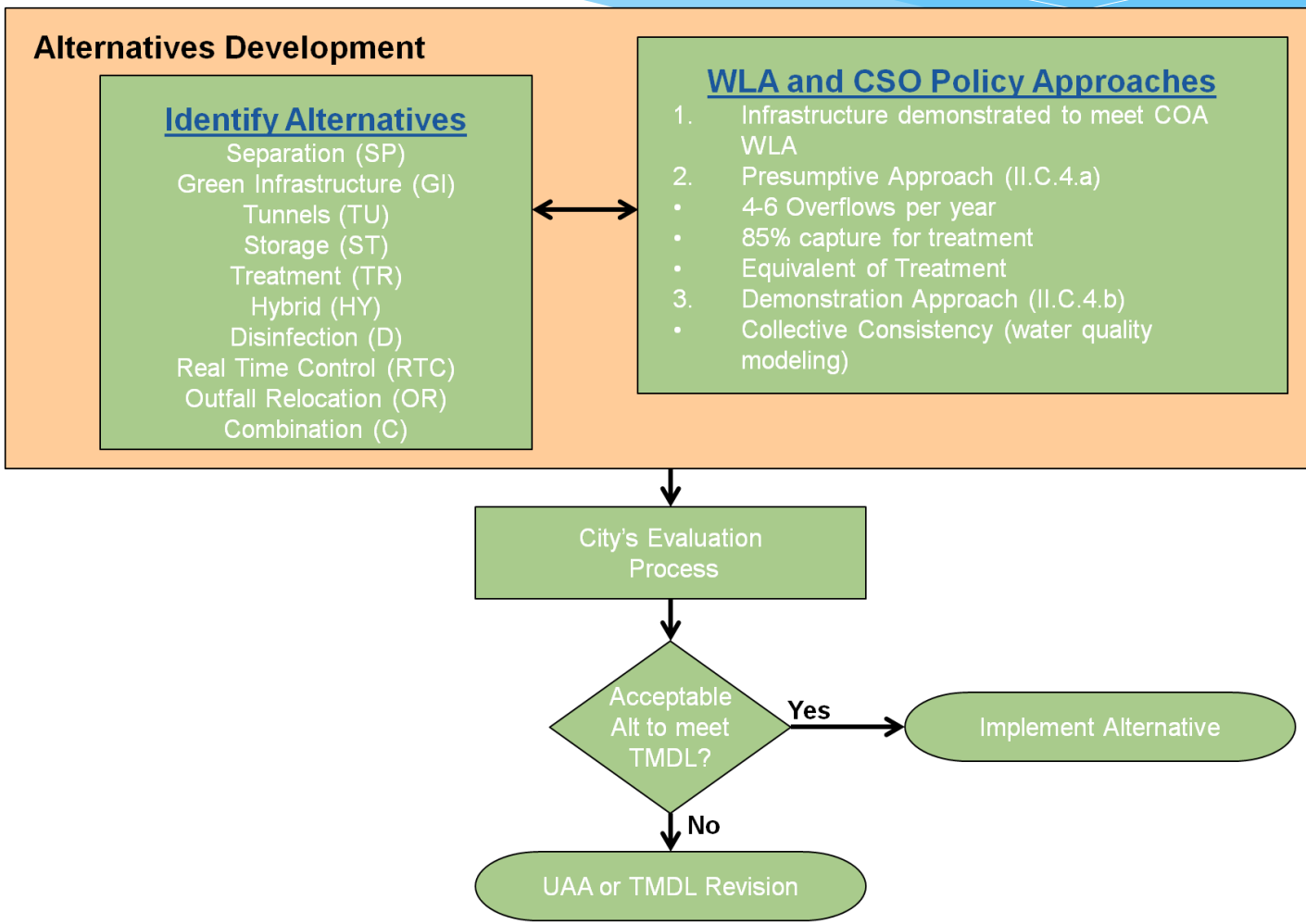
Regulatory Pathways

LTCPU Flow Chart



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Presumption Approach Performance

Presumption Approach Performance

Technology	# of Overflows per Year	% Capture*	% CSO Volume Reduction*	% Bacteria Reduction*
T1-A	3	96.9%	88.5%	88.5%
T2-A	4	95.4%	85.7%	85.7%
T3-A	4	95.4%	85.7%	85.7%
T4-A	4	94.2%	85.8%	85.8%
ST002-A	4	94.2%	85.8%	85.8%
ST003/4-A	4	96.1%	81.7%	81.7%
D002-A	53	59.6%	0%	99%
D003/4-A	60	78.9%	0%	99%
SE002	0	N/A	100%	72%
SE003/4	0	N/A	100%	78%
GI002	40-50	60%-70%	10%-20%	10%-20%
GI003/4	40-50	75%-85%	10%-20%	10%-20%

* based on overflows during the Typical Year 1984

Short Listed Strategies Exceed Presumption Criteria (Except GI)

Strategy	Description	Presumption Option i Overflows/Year 6 Maximum	Presumption Option ii % Capture 85% Minimum	Presumption Option iii Equivalent Load 85% Minimum
S-7	Storage Tunnel for 003/4 and Tank at 002	3-4	>94	>94
S-3	Separate Storage Tunnels 002 and 003/4 and Outfall Relocation for 002 to the Potomac	3-4	>94	>94
S-1	Storage Tunnels for 002/3/4	4	>94	>94
S-4	All Storage Tanks	4	>94	>94
S-8	Storage Tunnel for CSO-003/4 and Disinfection at CSO-002	3-4	>94	>94

Presumption Approach Conclusions

* All the Alternatives (*except green infrastructure*) meet or exceed the Presumption approach criterion for overflows per year (4 – 6 overflows per year)
* All the Alternatives (*except green infrastructure*) greatly exceed the Presumption approach criterion of volumetric capture (85% capture)
* All the Alternatives (*except green infrastructure*) greatly exceed the Presumption Approach criterion addressing capture for treatment (treat 85% of the overflow volume)

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Demonstration Approach
Water Quality Modeling

Demonstration Approach Key Matters

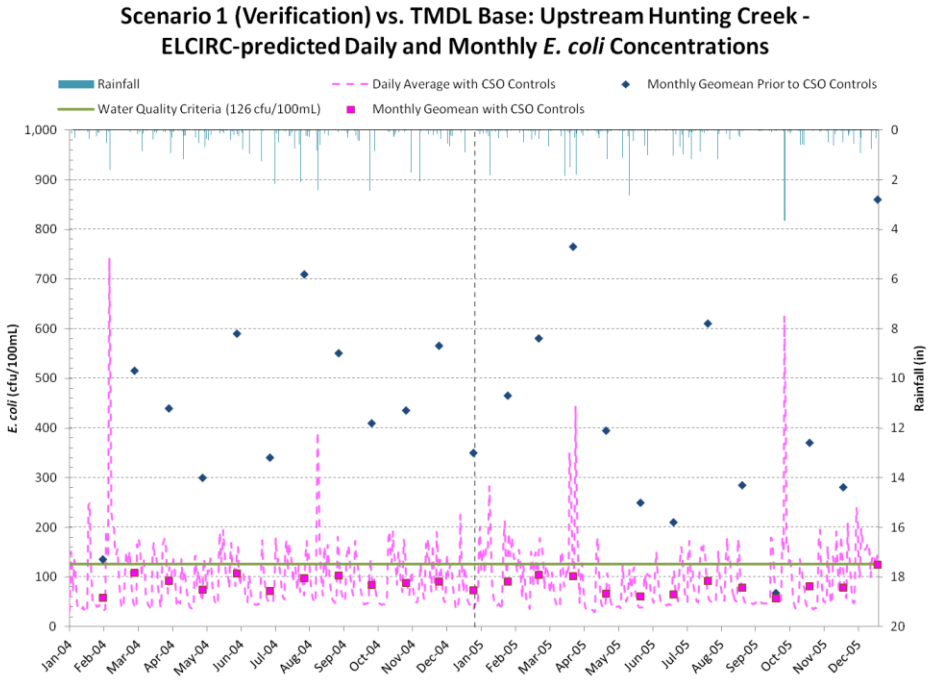
* WWTP (Load Collective Consistency)
* Potomac Boundary
* Proportional v. Discrete Controls
* Decay Rates

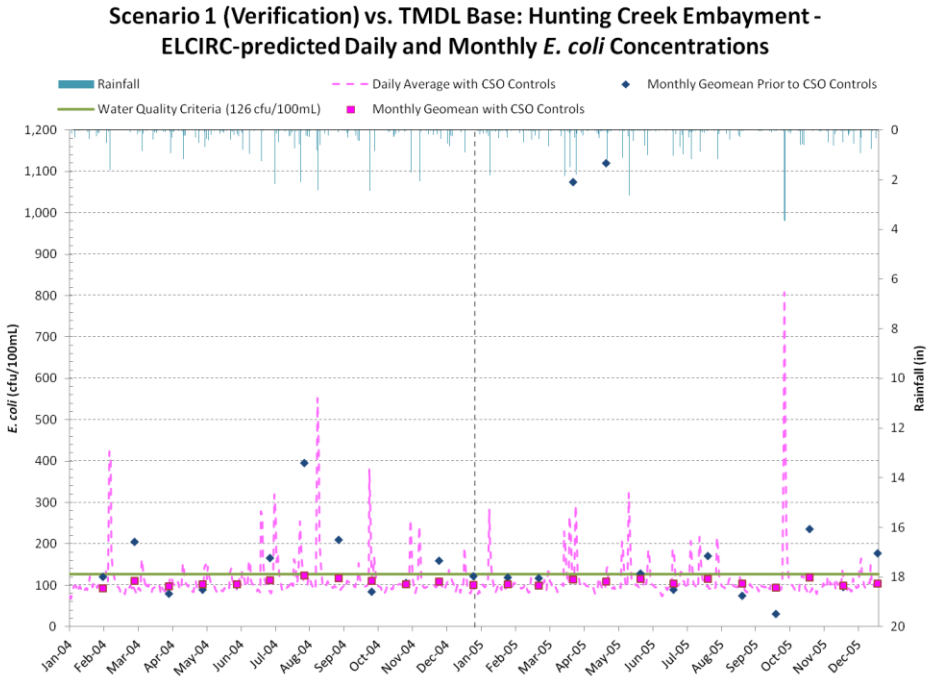
Model Scenario Runs

* 3 Model Scenarios were all run against the 2004-2005 climate period:
  - Scenario 1 – Verification with previous VIMS model
  - Scenario 2 – 1984 CSO control sizing, Collective Consistency, DEM-based Potomac River boundary conditions, DEM-based bacteria decay rate of 1.5/day
  - Scenario 3 – 1984 CSO control sizing, DEM-based Potomac River boundary conditions, DEM-based bacteria decay rate of 1.5/day

Scenario 1

Verification with VIMS previous modeling

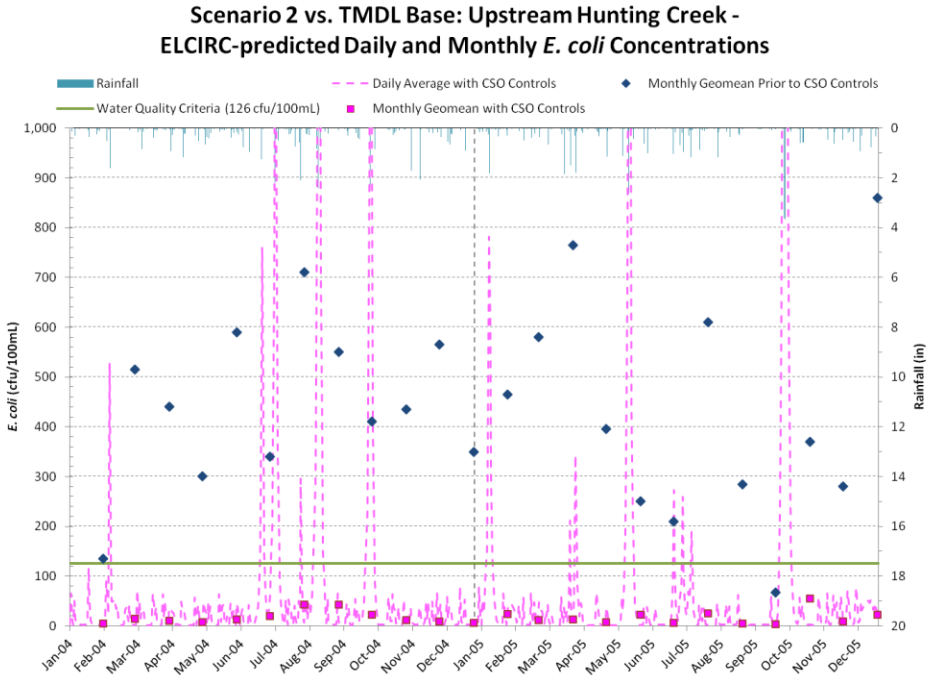


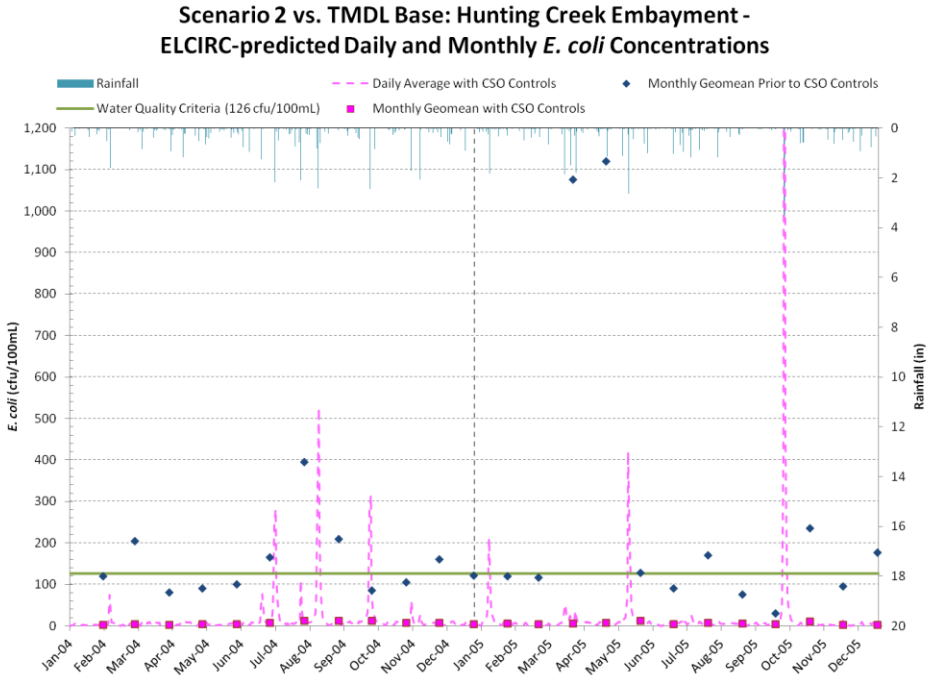


- Scenario 1 – proportional control of CSOs

Scenario 2

CSOs with Controls do not Cause or Contribute

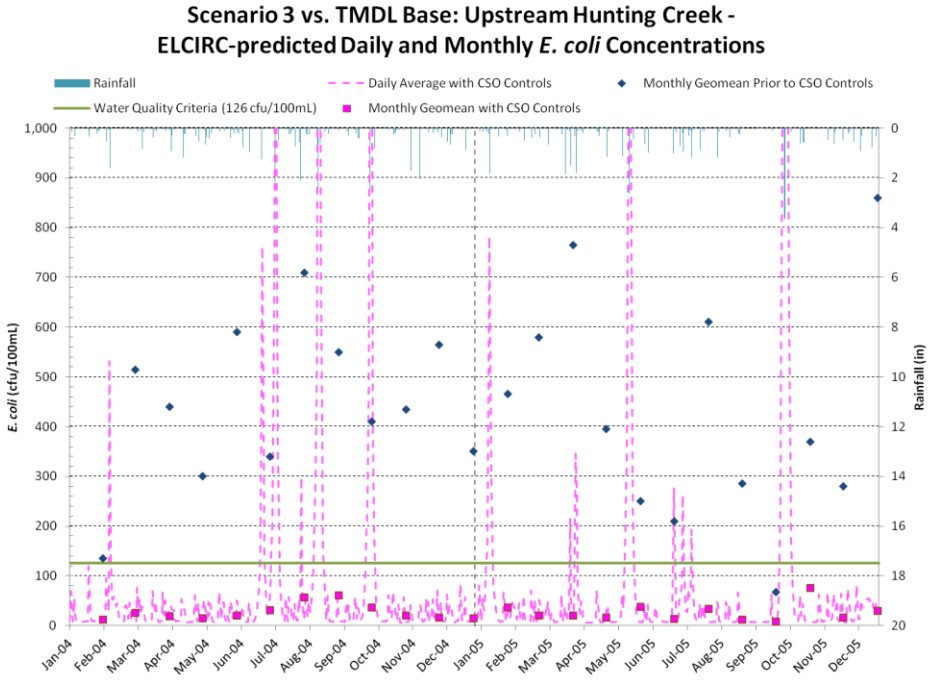


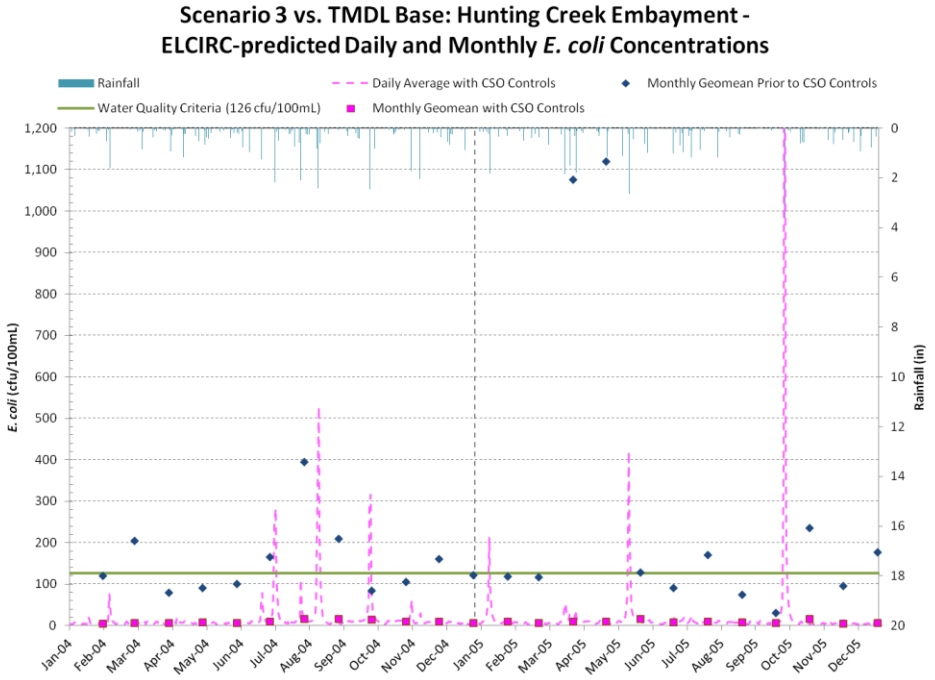


- Scenario 2 – 1984 CSO control sizing, Collective Consistency, DEM-based Potomac River boundary conditions, DEM-based bacteria decay rate of 1.5/day

Scenario 3

CSOs with Controls do not Cause or Contribute





- Scenario 3 – 1984 CSO control sizing, DEM-based Potomac River boundary conditions, DEM-based bacteria decay rate of 1.5/day

Demonstration Approach Conclusions

Not Needed

* WWTP Load (collective consistency)

Potentialy Needed

* Potomac Boundary

Needed

* Proportional vs. Discrete Controls
* Decay Rates

Demonstration Matters

* With Discrete Controls and DEM decay rate
  - The Alternatives under consideration do not cause or contribute to WQS violations using the 2004-2005 climate period
  - Collective Consistency is not needed
  - The CSO discharges can be viewed as a single allocation for the purposes of evaluating the WLA because they do not individually or together cause or contribute.

Demonstration Conclusion

1. The alternative CSO Controls are adequate to meet WQS based on the WLA and LA to other pollution sources in the Hunting Creek TMDL;
2. The CSO discharges remaining after implementation of the planned control program will not preclude the attainment of WQS or the receiving waters' designated uses or contribute to their impairment;
3. The planned control program provides the maximum benefits reasonably attainable; and
4. Green Infrastructure can be implemented if additional controls are subsequently determined to be necessary to meet WQS.

Presumption/Demonstration Level of Control

* The Demonstration Conclusions indicate that the presumption level of control for the selected alternatives (four overflows per year) exceeds that required to meet water quality standards and a level of control lower than that chosen would be adequate to meet the CSO Policy.

* Actual Level of Control to be constructed may be revisited after a alternative selection is made.

City of Alexandria, Virginia

Waste Load Allocation Evaluation

Waste Load Allocation Evaluation

* Annual Waste Load Allocation Control
* Collective Consistency
* Climate Period Considerations

Waste Load Allocation for COA Combined Sewer System - Discrete Controls

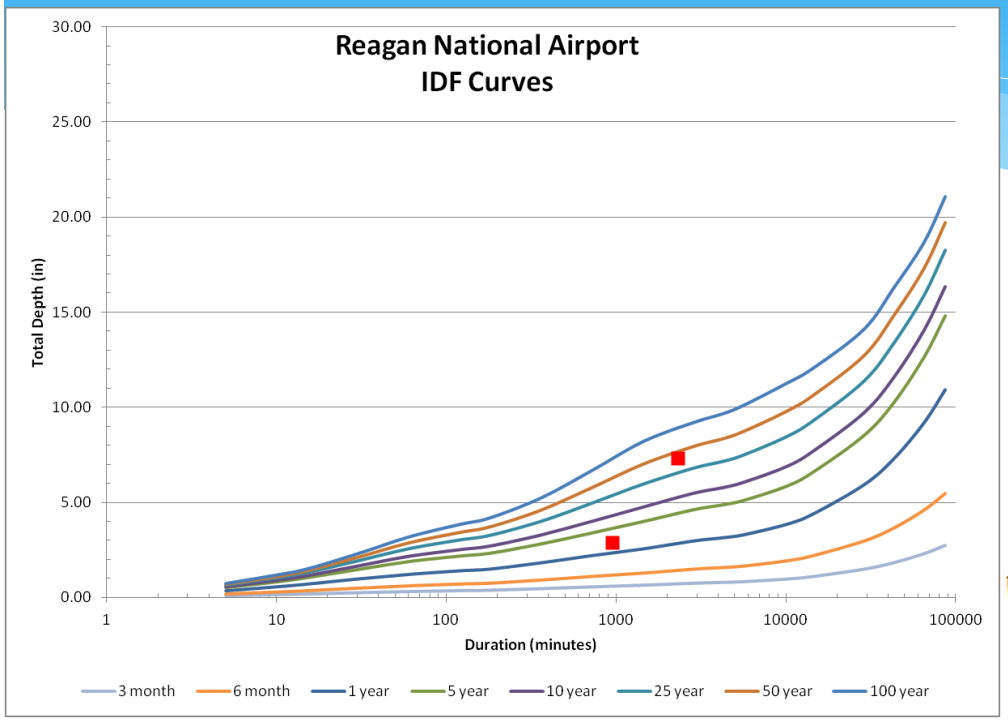
Alternative	Outfall	Wasteload Allocation (cfu/year)	Selected Alternatives Performance			
			Typical Year – 1984		TMDL Climate Period 2005	
			Load (cfu/year)	Meets Allocation?	Load (cfu/year)	Meets Allocation?
Category I - Hoofs Run/Hunting Creek Embayment	002	6.26E+13	2.48E+13	Yes	2.07E+14	No
	003/004	1.61E+12	7.90E+12	No	1.14E+14	No
	Total	6.42E+13	3.27E+13	Yes	3.22E+14	No
Category II - Hoofs Run/Potomac	002	6.26E+13	0	Yes	0	Yes
	003/004	1.61E+12	7.90E+12	No	1.14E+14	No
	Total	6.42E+13	7.90E+12	Yes	1.14E+14	No

2004-2005 Load Deficit Discrete Collective Consistency

Alternative	Total Allocation (cfu/year)	Category Load TMDL Climate Period 2005 (cfu/year)	Category Deficit (cfu/year)
Category I - Hoofs Run/Hunting Creek Embayment	6.42E+13	3.22E+14	-2.58E+14
Category II – Hooffs Run/Potomac	6.42E+13	1.14E+14	-4.98E+13

* 2004 annual load is less than the 2005 annual load

October 2005 Storm



$$Weibull\ Return\ Period = \frac{NMY + 1 - 2A}{M - A}$$

NMY = 40 = number of years
M = event rank in descending order
A = 0.4 = Weibull Position Parameter

$$Weibull\ Return\ Period = \frac{40\ years + 1 - (2 * 0.4)}{1 - 0.4} = 67\ year\ event$$

Year	Event	Rainfall (in)	Duration (hrs)	NOAA IDF Return Frequency[1]	Weibull Return Frequency[2]
2005	Oct. 7	7.30	39	43-year	67-year
2004	Aug. 12	2.43	6	3-year	1.1-year

[1] Return period interpolated from the Alexandria IDF curves developed in Atlas 14, Volume 2, Version 3
[2] Weibull Return Period based on 40 years used in the *Typical Year Selection TM* (1974-2013)

Waste Load Allocation for COA Combined Sewer System – without 2005 Extreme Storm

Alternative	Outfall	Wasteload Allocation (cfu/year)	TMDL Climate Period 2005	
			Load (cfu/year)	Meets Allocation?
Category I - Hoofs Run/Hunting Creek Embayment	002	6.26E+13	8.70E+13	No
	003/004	1.61E+12	3.65E+13	No
	Total	6.42E+13	1.23E+14	No (Yes with CC*)
Category II - Hoofs Run/Potomac	002	6.26E+13	0	Yes
	003/004	1.61E+12	3.65E+13	No
	Total	6.42E+13	3.65E+13	Yes

* Category I alternatives meet the WLA with an AlexRenew collective consistency of 53%. This would require a plant performance of 60 cfu/100mL
* 2004 annual load is *still* less than the 2005 annual load without the extreme storm event

How is the WLA Met?

Category	Typical Year 1984	TMDL Climate Period 2004-2005
Category I – S1,S4,S7 Hoofs Run/Hunting Creek Embayment	YES	Yes with 53% Collective Consistency and No Extreme Storm
Category II –S3 Hoofs Run/Potomac	YES	YES with No Extreme Storm Collective Consistency Not Needed
Category III – S2 Potomac	YES	YES

Waste Load Allocation Conclusions

* The Combined WLA to the three outfalls can be met:
  - For the typical year for all alternatives (4 overflows per year)
  - For the 2004-2005 Climate period
    - For the Category II Alternatives which discharge CSO-002 to the Potomac River
    - For the Category I Alternatives which discharge CSO-002 to Hunting Creek using Collective Consistency*
    - Does not meet the WLA with the October 2005 storm included

*Note the collective consistency need is approximately 50% of AlexRenew load

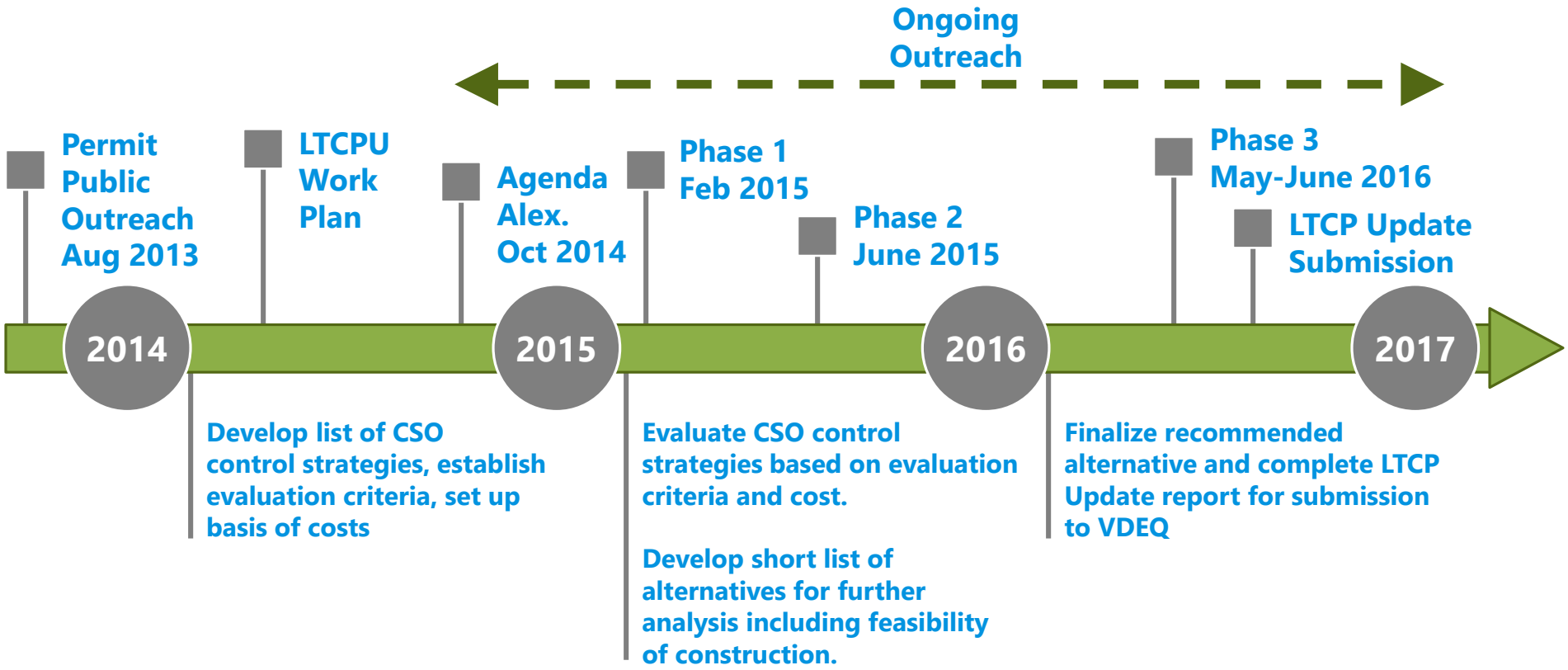
City of Alexandria, Virginia

Public Participation Status

Public Participation Plan

* Public participation for the LTCPU will occur in three phases and mirror those described in the *What's Next Alexandria* handbook
  - Phase 1 (Winter 2015)
  - Phase 2 (May-June 2015)
    - VDEQ Update Meeting on May 11, 2015
    - External Review Panel on May 15, 2015
    - Ongoing engagement with various Civic Associations and the EPC
    - **Public Meeting Scheduled for June 18, 7:00 pm – 9:00 pm**
  - Phase 3 (May-June 2016)

Planning Timeline



Next Steps

* Complete the Alternatives Analysis Technical Memoranda (May 2015)
* Complete the Water Quality Modeling (May 2015)
* Phase 2 Public Outreach (June 2015)
* Additional Feasibility Investigations (Summer 2015 – 2016)
* Implementation Plan (2016)
* Phase 3 Public Meeting (May-June 2016)
* Long Control Plan Update (August 2016)